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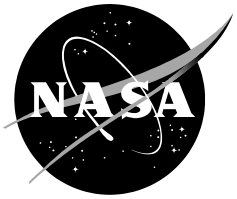

# PE99155 Point-Of-Load Buck Regulator Total Ionizing Dose Test Report

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**May 2023**

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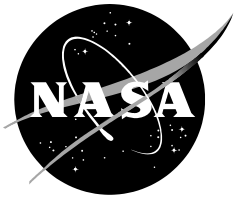

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# 1. INTRODUCTION

Teledyne's PE99155 point-of-load buck regulator was tested to evaluate an application-specific question about the start-up behavior of the device. This test determined if accumulated total ionizing dose (TID) affected any start-up voltage transient characteristics. Testing was based on pass/fail criterial for the magnitude of the output voltage to ensure the safety of downstream electronics. Two sets of radiation tests were performed. The first group of PE99155s used a high dose rate (HDR) irradiation to 25 krad(Si). A second group of PE99155s used high dose rate irradiation to 30 krad(Si).

# 2. DEVICES TESTED

## 2.1. Part Background

The PE99155 is a radiation tolerant point-of-load buck regulator [1]. The output voltage range is from 1.0V to 3.6V by external select resistors, and output currents up to 10A continuous.

## 2.2. Device Under Test (DUT) Information

Ten (10) parts from different lots of PE99155s were provided for total ionizing dose (TID) testing. All specifications and descriptions are according to the Teledyne's PE99155 datasheet. More information can be found in Table 1.

**Table 1. Part Identification Information**

| | |
|---|---|
| **Part Number** | PE99155 |
| **REAG ID#** | 19-001 |
| **Manufacturer** | Teledyne e2v |
| **Lot Date Codes** | 16480, 17213, 17245, 112572 |
| **S/N** | 19B029, 20B022, 20B037, 12B059, 08B030, 12B042, 05A030, 20E39, 20E40, 12B006 |
| **Quantity Tested** | 10 |
| **Part Function** | Point-of-Load Buck Regulator |
| **Part Technology** | UltraCMOS |

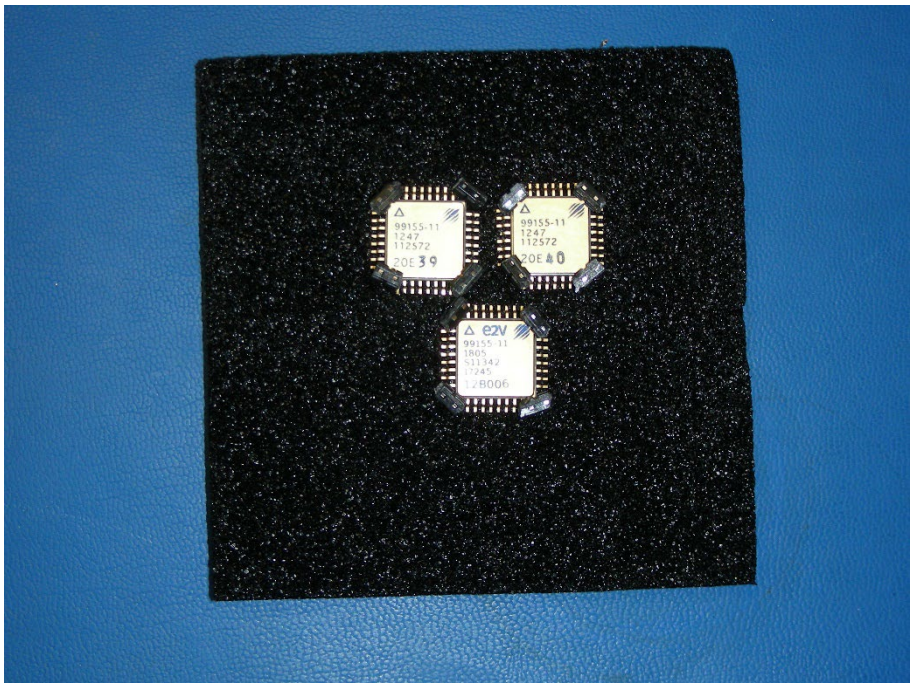

Fig. 1. PE99155.

## 3. TEST SETUP

The PE99155 was mounted in a socketed printed circuit board provided by the manufacturer.

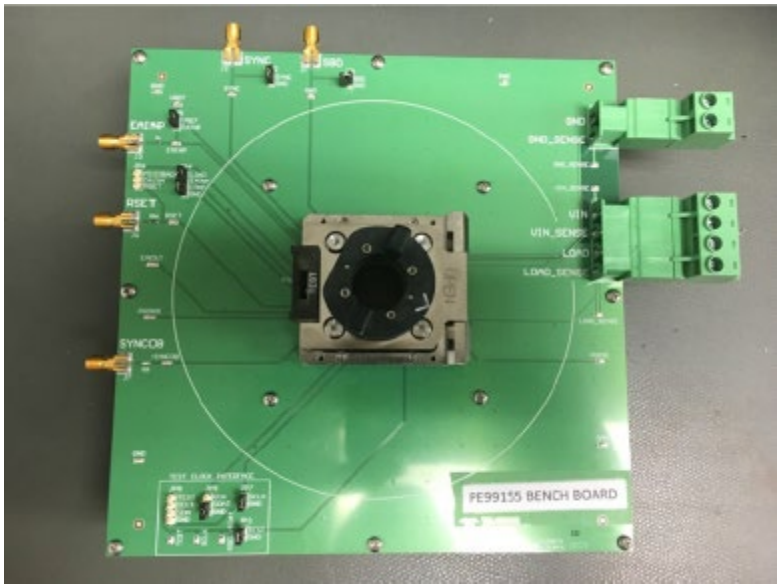


Fig. 2. Socketed Bench Board

Agilent N6700B mainframe chassis, Agilent N6754A 60V/20A/300W module and Agilent MS07104 digital oscilloscope were used to measure any PE99155 transients while toggling between the on/off state 200 times.

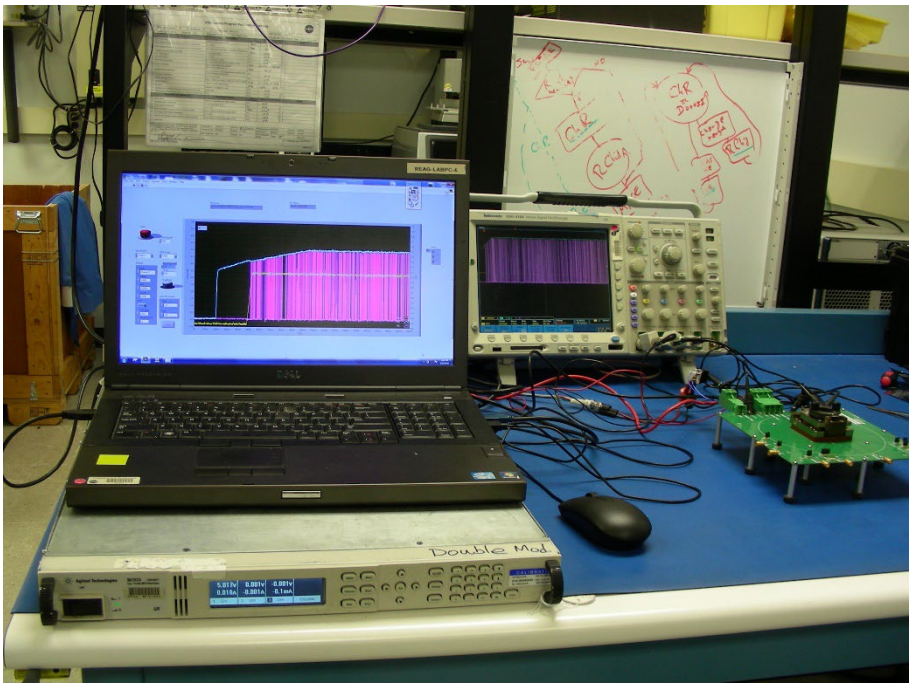

Fig. 3. DUT test set-up

# 4. TEST DESCRIPTION

## 4.1 Irradiation Conditions

The parts were exposed to gamma radiation at a high dose rate. The first group contained four (4) parts. The second group contained six (6) parts. Prior to the first radiation dose, all parts were electrically tested. After each dose step, the parts were electrically tested using the failure criteria and returned to radiation chamber. All parts were unbiased during the irradiation steps. See Table 2 for more information, and Fig. 4 for the irradiation set-up.

**Table 2. Radiation Parameters**

| Group | Qty | Bias | Dose Rate | Dose Level Steps (krad(Si)) |
|---|---|---|---|---|
| 1 | 4 | Unbiased | 500 rad(Si)/min | 0, 5, 15, 25 |
| 2 | 6 | Unbiased | 500 rad(Si)/min | 0, 10, 15, 30 |

Fig. 4. Irradiation Set-up

### 4.2 Electrical Tests

The power supply is turned on/off. The power supply is toggled on/off 200 times or until the failure criteria is reached.

**Table 3. List of Necessary Equipment**

| Make | Model | Comment |
|---|---|---|
| Agilent | N6700B | Mainframe Chassis |
| Agilent | N6754A | 60V/20A/300W Module |
| Agilent | MS07104 | Digital Oscilloscope |

## 5. Failure Criteria

If $V_{out}$>1.05V occurs at startup, the unit fails and the oscilloscope triggers. Each failure is recorded during the 200 cycle test.

## 6. SOURCE REQUIREMENTS

The total dose source is in a room air source gamma ray facility, which is compliant with MIL-STD-883, Method 1019 [2]. Dosimetry is NIST traceable.

## 7. RESULTS

The radiation effects and analysis group received the parts on 2/5/2019. Group one was TID tested on 4/12/2019. Group two was divided into two testing dates 2/9/2022 and 2/10/2022 due to the time required to take measurements.

One PE99155 (Date Code: 16480 and S/N: 12B059) in group one failed between the 10 krad(Si) and 25 krad(Si) steps as seen in Table 4. Three failures were recorded for this device for the 200 on/off cycles. The rest of the parts passed up to 25 krad(Si).

**Table 4. DUT Start-Up Transient Acceptance Group 1**

| Date Code | S/N | 0 krad(Si) | 5 krad(Si) | 10 krad(Si) | 25 krad(Si) | Number of Failures at 25 krad(Si) |
|---|---|---|---|---|---|---|
| 16480 | 19B029 | Pass | Pass | Pass | Fail | 3 |
| 16480 | 20B022 | Pass | Pass | Pass | Pass | 0 |
| 16480 | 20B037 | Pass | Pass | Pass | Pass | 0 |
| 17245 | 12B059 | Pass | Pass | Pass | Pass | 0 |

All PE99155 parts in group two passed up to 30 krad(Si) as seen in Table 5. There are no failures to report for any dose step in group two.

**Table 5. DUT Start-Up Transient Acceptance Group 2**

| Date Code | S/N | 0 krad(Si) | 10 krad(Si) | 15 krad(Si) | 30 krad(Si) |
|---|---|---|---|---|---|
| 16480 | 08B030 | Pass | Pass | Pass | Pass |
| 16480 | 12B042 | Pass | Pass | Pass | Pass |
| 17213 | 05A030 | Pass | Pass | Pass | Pass |
| 112572 | 20E39 | Pass | Pass | Pass | Pass |
| 112572 | 20E40 | Pass | Pass | Pass | Pass |
| 17245 | 12B006 | Pass | Pass | Pass | Pass |

## 8. SUMMARY

Two groups of PE99155 were irradiated at a gamma facility. In the first group, one device met the failure criteria somewhere between 10-25 krad(Si), and had three failures out of 200 on/off cycles. In the second group all parts passed up to and including 30 krad(Si).

## 9. REFERENCES


1) Teledyne e2v, "Radiation tolerant point-of-load buck regulator", PE99155 datasheet, 2019
2) Department of Defense "Test Method Standard Microcircuits," MIL-STD-883 Test Method 1019.9 Ionizing radiation (total dose) test procedure, June 7, 2013, https://landandmaritimeapps.dla.mil/Downloads/MilSpec/Docs/MIL-STD-883/std883.pdf.